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Seasonal prevalence of *Culicoides* species in Northern Districts of Telangana, South India

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Abstract
A study was conducted to observe the prevalence of *Culicoides* in cattle, buffalo, sheep and goat farms in rural and urban districts of Telangana state India. The collection was done from dawn to dusk for the period of one year (June, 2017 to May, 2018) covering the different seasons. CDC-UV light trap connected with suction fan was placed at the farms. A total of 18,800 flies were collected in which 15,500 (82.45%) were female and 3,300 (17.55%) were males. The species included 8,200 (43.62%) *C. oxystoma*, 5,405 (28.75%) *C. imicola*, 4,805 (25.56%) *C. peregrinus*, 300 (1.59%) *C. actoni* and 85 (0.45%) *C. anophelis*. *C. oxystoma* and *C. imicola* were the most predominant species in rural and urban districts of Telangana. Out of 18,800 number of *Culicoides* collected, the midges in rainy season were highest amounting to 9,249 (49.19%), followed by winter season as 6,820 (36.27%) and summer season 2,721 (14.47%).

Keywords: *Culicoides* species, UV light trap, seasonal prevalence, Telangana

Introduction
The *Culicoides* genus has more than 1400 species identified worldwide which are obligate blood feeders of mammals and birds including humans. They occur on all land masses except Antarctica and New Zealand (Mellor *et al.*, 2000) [9]. *Culicoides* are the prime vectors for arboviruses such as Bluetongue, African horse sickness, epizootic haemorrhagic disease and bovine ephemeral fever and some protozoans. There are reports of the species from different parts of India but there is no available information on these midges in Telangana. The climate is typically tropical, the mean annual precipitation of rain annually is 1800 mm with 82 percent of rainfall from south west monsoon. In Northern Telangana open wells are the main source of water for irrigation followed by canals. Therefore a systematic study was undertaken to know the seasonal prevalence of *Culicoides* species in Northern Districts of Telangana.

Materials and Methods
The climate of North Telangana region is classified as hot humid with minimum and maximum temperatures during winter, summer and monsoon seasons being: 13.0 ℃ and 25.0 ℃; 15.0 ℃ and 37.7 ℃; and 21.0 ℃ and 30.0 ℃ respectively. The mean annual rainfall is about 1800 mm, from south-west monsoon. The moist environment and marshy landscape of the Telangana provides ideal conditions for the habitation and survival of the *Culicoides* midges.

The seasonal prevalence of *Culicoides* sp. was studied in twelve different farms (Table 1) of cattle, buffalo, sheep and goats in Northern districts of Telangana. The flies were collected with CDC –UV light traps and a suction fan during rainy, winter and summer seasons.

North Telangana Zone (NTZ) has three seasons viz. rainy (June, July, August and September), winter (October, November, December and January) summer (February, March, April and May).

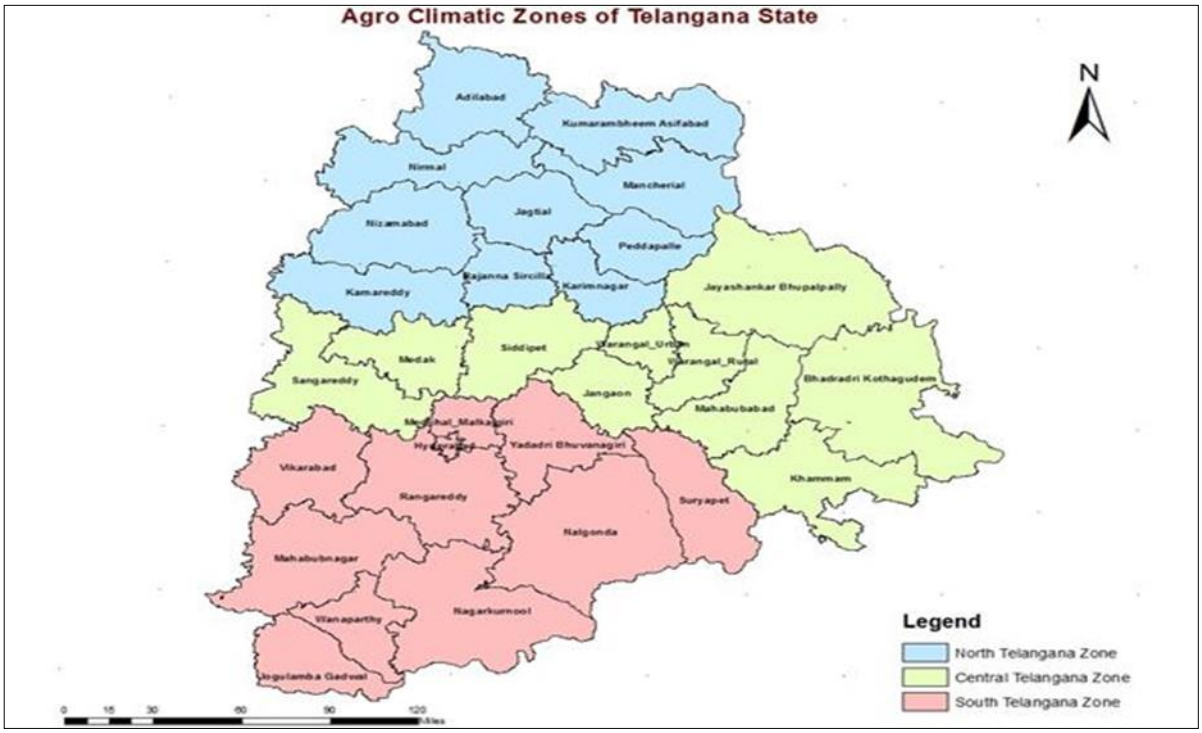

Fig 1: The present study was undertaken in different livestock farms of (Cattle, Buffalo, Sheep and Goats) Telangana.

Table 1: Particulars of collection of *Culicoides*

S. No	Places of collection
1	LFC (Livestock Farm Complex), CVSc, Korutla (Cattle Farm)
2	LFC (Livestock Farm Complex), CVSc, Korutla (Sheep Farm)
3	Jagtial Sheep & Goat Farm
4	Jagtial Cattle Farm
5	Warangal Cattle Farm
6	Warangal Sheep Farm
7	Karimnagar Cattle Farm
8	Karimnagar Sheep Farm
9	Mahaboobabad Sheep Farm
10	Mahaboobabad Cattle Farm
11	Kama Reddy Cattle Farm
12	Kama Reddy Sheep Farm

During the study period, the flies were collected with CDC-UV light trap (Model 2770: BioQuip Products, CA, USA. Operating on 6 Volts DC, the trap uses 8 LED (light emitting diode) elements to provide 360 degree coverage in the horizontal plane) connected to suction fan from evening hours to morning hours i.e., 6 pm to 6 am (dawn & dusk). The light trap was hung at livestock premises and was suspended from the walls of building at 1.5–2.0 m above the ground level at night. The light trap with collecting beaker containing 200 ml distilled water to which a drop of detergent was added to reduce the surface tension for sinking of *Culicoides* (Lara E. Harrup, 2016) [6]. The collected insects were transported to the laboratory and separations were made based on different sieves and separated *Culicoides* were preserved in 70% ethyl alcohol.

Gross identification of *Culicoides* was carried out based on wing pattern initially and confirmed subsequently by mounting different parts of the specimen in a drop of phenol-balsam mixture on microscopic slides after clearing in liquefied phenol solution for 8 h (Wirth and Marston, 1967) [18]. The criteria for morphological identification of *Culicoides* sp. include wing length, antennal ratio, costal ratio, antennal sensillar pattern, palpal ratio proboscis-head ratio and Hind tibial spine (largest spine from spur). Morphological identification of *Culicoides* sp. was done based on the keys and description of Wirth & Hubert (1989) [17].

Results

A total of 18,800 *Culicoides* were collected from different farms of rural and urban districts of Telangana, South India. Out of which 15,500 were female *Culicoides* (82.44%) and 3,300 were male *Culicoides* (17.55%). From a total of 18,800 number of midges collected highest number was seen in rainy season 9,249 (49.19%), followed by winter 6,820 (36.27%) and summer seasons 2,721 (14.47%). Morphologically, a total of five different species were identified including *C. oxystoma, C. imicola* and *C. peregrinus* being the most predominant species followed by, *C. actoni* and *C. anopheles*. In rainy season *C. oxystoma* was found to be the highest followed by *C. imicola, C. peregrinus, C. actoni* and *C. anophelis*. In summer season *C. oxystoma* was found to be the highest followed by *C. peregrinus, C. imicola, C. actoni* and *C. anopheleis* in winter *C. peregrinus* is highest followed by *C. oxystoma, C. imicola, C. actoni* and *C. anophelis*. The characters are detailed as below.

Table 1: Morphometric measurements of *Culicoides* species

Species	Wing Length (mm)	Costal ratio	Antennal ratio	Antennal sensillar pattern	Palpal ratio	P/H ratio	Hind tibial spine (largest spine from spur)
C.peregrinus	1.19	0.64	1.18	3, 11-15	2.9	0.92	6(II)
C.oxystoma	1.0	0.53	1.04	3, 8-10	1.99	0.66	4(I)
C.imicola	0.93	0.54	1.04	3, 12-15	2.4	0.87	5(I)
C.actoni	0.83	0.56	1.1	3, 12-15	2.18	0.73	5(I)
C.anophelis	1.1	0.71	0.96	3, 11-15	2.2	0.38	4(II)

Table 2: Season wise distribution of different species of *Culicoides*

Culicoides spp.	Rainy		Winter		Summer		Total	Percentage (%)
	Female	Male	Female	Male	Female	Male		
C.oxystoma	3,389	693	1,732	309	1,028	246	7,397	39.34
C.imicola	2,311	476	1,644	160	509	105	5,205	27.68
C.peregrinus	1,775	377	2,625	250	573	78	5,678	30.20
C.actoni	154	32	60	13	32	12	303	1.61
C.anophelis	35	7	21	6	12	6	87	0.46
Total	7,664	1,585	6,082	738	2,254	467	18,800	100%

Discussion

In the present study females (82.44%) were more than males (17.55%) as earlier reported by Foxi and Delrio (2011) [5]; Satheesha *et al.,* (2006) [13]; and Kim *et al.,* (2012) [8]. The reason could be due to female midges are obligate blood feeders require for oviposition moreover males are not blood feeders and they die after mating. Similar observations were made by Wirth and Hubert, (1989) [18]; from south East Asia, Das gupta, (1995) [4] from Kolkata.

In the present study *C. oxystoma, C. peregrinus* and *C. imicola* were the most predominant species which was corroborated with the findings of Archana *et al.,* (2014) [1] who recorded the species from rural and urban districts of Bengaluru, Karnataka; Bhoyar *et al.,* (2009) [2] and Satheesha *et al.,* (2006) [13] from Bidar, Karnataka; Narladkar *et al.,* (1993) [10]; Narladkar and Shivpuje (2014) [11] from Maharastra; Ganesh Udupa, (2001) [16] from Tamilnadu; Ilango (2006) [7] in Tamil Nadu, whereas Reddy and Hafeez, (2008) [12].reported *C. oxystoma* the predominant species from Andhra Pradesh. *C. Oxystoma* and *C. peregrinus* also reported by Sen and Fletcher (1962) [15] from Assam and Bengal and other parts of India. Similar findings by Sen and Dasgupta (1959) [14]. The variation in species composition in different areas might be due to different agro climatic zones.

The present study recorded highest number of *Culicoides* during rainy season and lowest in summer seasons. The reason could be due to less humidity, desiccated temperatures, low rain fall and high air velocity decreased the propogation of *Culicoides* in summer. The present observation is in accordance with Narladkar *et al,* (1993) [10] who recovered seasonal composition as 75.38% in rainy season, 19.75% in winter and 4.85% in summer. Rainfall played a major role on the prevalence of *Culicoides* as also observed by Dasgupta, (1962) [15].who conducted comprehensive studies on Indian *Culicoides* in and around Kolkata.

Conclusion

In present study the findings are, in rainy season *C. oxystoma* was found to be highest followed by *C. imicola, C. peregrinus, C. actoni and C. anophelis* and in winter *C. peregrinus* was more followed by *C. oxystoma, C. imicola, C. actoni and C. anophelis* and in summer *C. oxystoma* was found to be highest followed by *C. peregrinus, C. imicola, C. actoni and C. anopheles.* During rainy season recorded highest number of *Culicoides* and lowest in summer season because rainfall played a major role in prevalence.

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